Introduction

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A New Technology Emerges

Wastewater professionals have long recognized the cleansing abilities of wetland systems. But until recently, there were limited data available about these systems. Pioneers in this industry designed wetland systems based on ingenuity and limited performance data. Today, due to their efforts, there are many operating constructed treatment wetlands both nationwide and in Colorado. Ingenuity is no longer the key factor to design wetlands – publicly available data is.

In 1999, the Governor's Office of Energy Management and Conservation (OEMC) recognized the need to collect and disseminate this data and embarked on a program to evaluate and document constructed treatment wetland features and performance in Colorado. The OEMC's timely implementation of this inventory will help all future builders of constructed treatment wetlands in Colorado and other parts of the country.

In Search Of Excellence – A Comprehensive Approach

The OEMC began this effort by selecting experts from various groups involved with wetlands and wetlands issues. These individuals comprise the OEMC Wetlands Task Force. The Task Force provided expertise and advice to guide the project and establish requirements for evaluating wetland data.

To implement the program, the OEMC requested proposals from qualified firms to locate, catalog and document the efficiency of Colorado's constructed treatment wetlands. From that request, the Task Force and OEMC selected the engineering-biologist team of HDR Engineering, Inc. and ERO Resources. Including both engineers and biologists in the inventory allowed a comprehensive review of the wetland treatment systems – from engineering details to habitat value. The team collected data to assess design features, energy

savings, flora and fauna biodiversity, general operational problems, and to develop "lessons learned" from existing treatment wetlands in Colorado (discussed in Chapter 8 of this report). From this inventory, the team created a database compatible with the North American Treatment Wetland Database (NADB).

A Vision For The Future

A future that includes safe water supplies and functioning natural waterways and riparian habitats must also include the wise management of our wastewater. Engineers and government agencies both have visions of using wetlands more often as a natural way not only to maintain the environment, but also to enhance water quality and reduce energy costs. Developing an ideally functioning wetland that incorporates "best practices" from this inventory to guide other wetland designers is one of the OEMC's goals. This project is the stepping-stone to achieve that goal.

Based on this inventory (Phase I), the OEMC plans to develop a demonstration project to incorporate the most effective features of all the wetlands evaluated (Phase II). Phase II will require a partnership between the OEMC, an engineering consultant, and a community, or other group, wishing to build a wastewater treatment facility using wetlands, and potentially the Department of Energy (DOE), US Environmental Protection Agency (EPA) or other regulating agencies. Ideally, the wetlands project will incorporate energy savings, efficiency, improved water quality for stream or river discharge, high-value wildlife habitat, and walking trails for wildlife viewing. Phase II will consider general quality-of-life issues such as buffers between developments or communities to address "smart growth" issues and acquisition of open space. The Request For Proposal (RFP) for Phase II will most likely be released in the late summer or early fall of 2001.

Wetlands – Why Are They So Important?

Natural purification barriers: As natural water purification barriers, wetlands are typically a relatively low cost, low energy method to improve water quality. Because of land development practices during the last few decades, many natural wetlands have been dewatered. This reduction in wetland area has resulted in larger amounts of pollutants such as fecal coliform, total suspended solids, bacteria, viruses, algae and other organic and inorganic matter entering water bodies. This results in increased turbidity, decreased oxygen, and unnatural variations in pH and temperature. Recently, in an effort to counteract these results, a shift towards wetland area protection has occurred as the cleansing capabilities of wetlands have been recognized.

Natural cleansing process: The cleansing processes identified in natural wetlands can be mimicked in constructed treatment wetlands. Constructed treatment wetlands are designed to maximize the natural abilities of wetlands to remove pollutants from a variety of wastewater sources. This study focuses on the use of constructed wetlands for the treatment of municipal wastewater.

Water – A Limited Resource

"When the well's dry, we know the worth of water" – Benjamin Franklin

Earth is often referred to as the water planet because more than 70% of the earth's surface is covered with water. Since this resource is seemingly abundant it is easily taken for granted. This apparent abundance is deceptive, as only 3% of the earth's water is fresh, and two-thirds of that is trapped in glaciers and icecaps. So the issue that must be dealt with is not water supply, but water quality. With a limited amount of fresh water and an increasing global population, wise management of water supplies is essential. It is important for societies to recognize the value of protecting the quality of this limited and valuable resource.

The OEMC recognized this need and embarked upon this project.

Constructed wetlands are a viable treatment alternative for many reasons. Treatment wetlands remove solids, oxygen depleting pollutants, and lower bacterial and viral levels. Unlike traditional treatment methods, wetlands offer many ancillary benefits. These benefits, including wildlife habitat, and aesthetic and educational values, were evaluated, as was the wetland's ability to successfully meet its treatment goals.

Identifying Colorado's Treatment Wetlands

Phase I of the Colorado Constructed Treatment Wetlands Inventory was a reconnaissance effort to locate wetlands in Colorado used to treat point source pollutants. The project team performed a literature review, pursued leads provided by the OEMC and Task Force, and used local community knowledge to identify appropriate wetland sites. From a preliminary list of constructed treatment wetlands, the Task Force developed a final list to include in this study. The criteria used to determine whether a site would be included on the final list are as follows:

➤ Constructed wetland must be treating a point source.

➤ Data must be available in order to assess the wetland's wastewater treatment efficiency.

Twenty sites met both of the above criteria. Wetland site locations varied from locations such as Dove Creek to Avondale. While examples of other types of wetlands are included in the study, most of them were not included in the more rigorous analysis. Chapter 6 contains detailed analyses of the sites visited.

So…Are We Meeting Government Standards?

The HDR/ERO team considered both engineering and biological parameters in their wetland evaluations. The team made site visits to the selected wetlands and used a Site Data Sheet (SDS) to provide a consistent method for evaluating each site. The evaluation process allowed for an independent review of both the engineering and biological aspects. The inventory provided a 'snapshot' of how the wetland was performing on the date of the site visit. Water quality records and historical information were gathered during an interview with a wetland contact person; as well as from the Colorado Department of Public Health and Environment's (CDPHE) permit files.

What does this mean? It means information will now be in one location and accessible for comparison. This will allow future wetland designers to determine which practices best meet their goals. Chapter 8 discusses how our findings compared to CDPHE's regulations, as well as "lessons learned."

From Local to National – Making the Information Available

In the early 1990's the US EPA sponsored the creation of a database containing design and performance information about constructed treatment wetlands. This information was used to develop design guidelines and to chronicle the successes and failures of wetland systems. Prior to the Colorado Constructed Treatment Wetland Inventory project, only one Colorado wetland was included in the database. A primary goal of this study was to collect data on Colorado's treatment wetlands for entry into the National Database. The team developed the SDS with this goal in mind and designed a database compatible with the NADB to store this information. The information gathered through this inventory is available from the OEMC. Future designers can use the data as a tool for comparative analysis and to help guide them in making design decisions for their wetland.

'Lessons Learned' From Those Involved With Existing Wetlands

Wastewater treatment using constructed wetlands involves different processes than conventional treatment methods. Operators, designers, and local officials must approach the implementation and operation of constructed wetlands with an understanding of the natural treatment processes involved. Information collected from the existing Colorado treatment wetlands details the challenges of designing and operating these systems and chronicles the innovative solutions developed to meet them. The ultimate goal of this project is to disseminate information regarding the use, design, operation, and performance of constructed treatment wetlands in Colorado. This will assist future wetland designers and operators to learn from the past experience of others.

Who's Who In Treatment Wetlands In Colorado

Over the course of this project, the HDR/ERO team developed a contact list. This list is provided at the end of Chapter 8 to facilitate communication between those with knowledge about these systems and those interested in learning more.

Final Report

The Colorado Constructed Treatment Wetlands Inventory report documents experiences with Colorado's treatment wetlands. A description of individual sites is discussed in Chapter 6 and general observations from the project are presented in Chapter 7. The OEMC, Task Force and HDR/ERO team hope this document will serve as a resource for those interested in using constructed wetlands as an effective and low energy method of treating wastewater.

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